

**TITLE OF OC PROJECT: Next Generation Personalized EDGE-AI HealthCare (Next Gen PLEDGE)**

**ABSTRACT** - During the last decade the digital revolution has accelerated the development of applications that enable a more efficient management of patients with chronic conditions, congestive heart failure, stroke or chronic obstructive pulmonary disease. More recently, the cross fertilization of ICT has allowed the development of advanced remote monitoring systems capable of providing continuous insight into the physiological condition and wellbeing of individuals. Such systems reduce hospitalizations, empower individuals and support their wellbeing, reduce negative impact of modern lifestyles, while significantly enhancing their arsenal combating societal changes with profound consequences on European citizens and healthcare systems. **Next-Gen-PLEDGE innovative approach aims to develop and provide advanced remote monitoring systems, improving the capabilities of early detection of disease symptoms or pathology and respond to them in a timely manner, offering a solution that encompasses TERMINET's framework for testing, validating, and demonstrating federated models and machine learning algorithms in a personalized healthcare scenario.** Our concept encompasses a personalized system consisting of a patch and wrist wearable that, in conjunction with a mobile device, is able to exploit the potential of Next Generation IoT through federated learning, by moving decisions closer to the end user. Next Gen PLEDGE is able to utilize raw data such as pulse waveforms, temperature data and electrocardiography (ECG) waveforms captured by the wearable sensors, build a personalized AI-model through on-device learning and convert them into measurements of actual precise health data such as, Respiratory Rate, Blood Oxygen Saturation, Body Temperature, Heart Rate and Heart Rate Variability, while taking personal physiological and behavioural user characteristics into account. Our unique proposition increases the relevance to the specific challenges of TERMINET and its innovation capacity, as well as the impact and importance of the use cases that this call is targeting.

**INTRODUCTION**

NextGenPLEDGE focuses on cardiorespiratory chronic diseased population.

World Health Organization (WHO) reports that chronic respiratory diseases together with cardiovascular disease and cancer accounts for 80% of deaths in Europe and lung disease accounts for an estimated 7.5 million deaths per year, or approximately 14% of annual deaths worldwide.

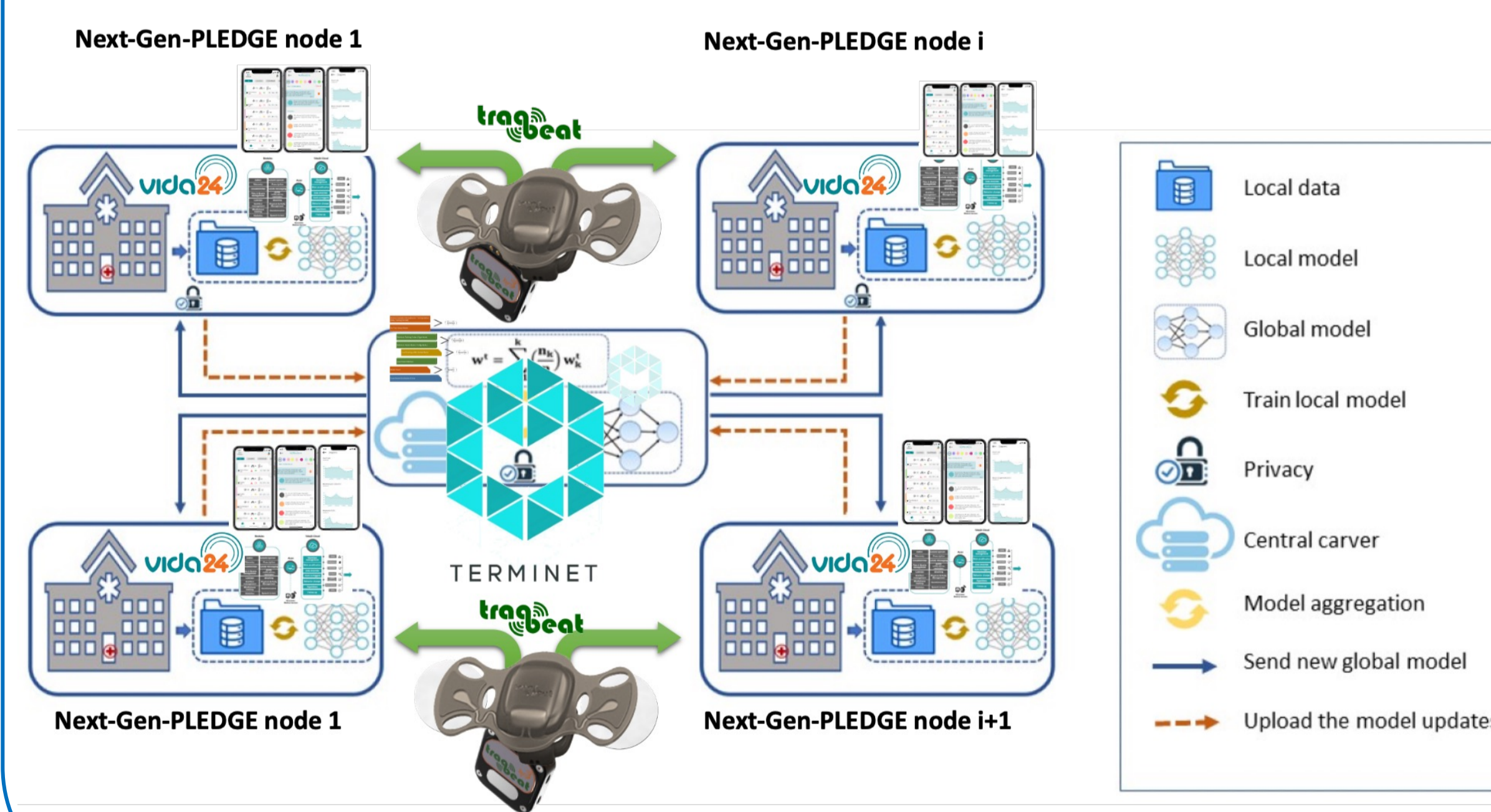
Comorbidities are also strongly associated with a high use of healthcare resources. Acute and chronic cardiorespiratory illnesses (accounting for 34% of acute hospital admissions worldwide) are a major burden for hospital admissions. This became even more evident during the COVID19 pandemic where healthcare systems exceeded their capacity while redeploying up to 94% of staff. This resulted in "neglecting" chronic illness patients who either were afraid to attend hospitals or could not receive timely care.

A large proportion of cardiorespiratory patients attending secondary hospital care with low-intermediate risk of deterioration could benefit from being discharged early or not admitted at all or even be triaged faster while in the hospital, if and only if medical teams had a reliable tool to perform continuous monitoring of patients' vital signs/give advice thus shifting lower risk patient care in a home setting.

**METHOD**

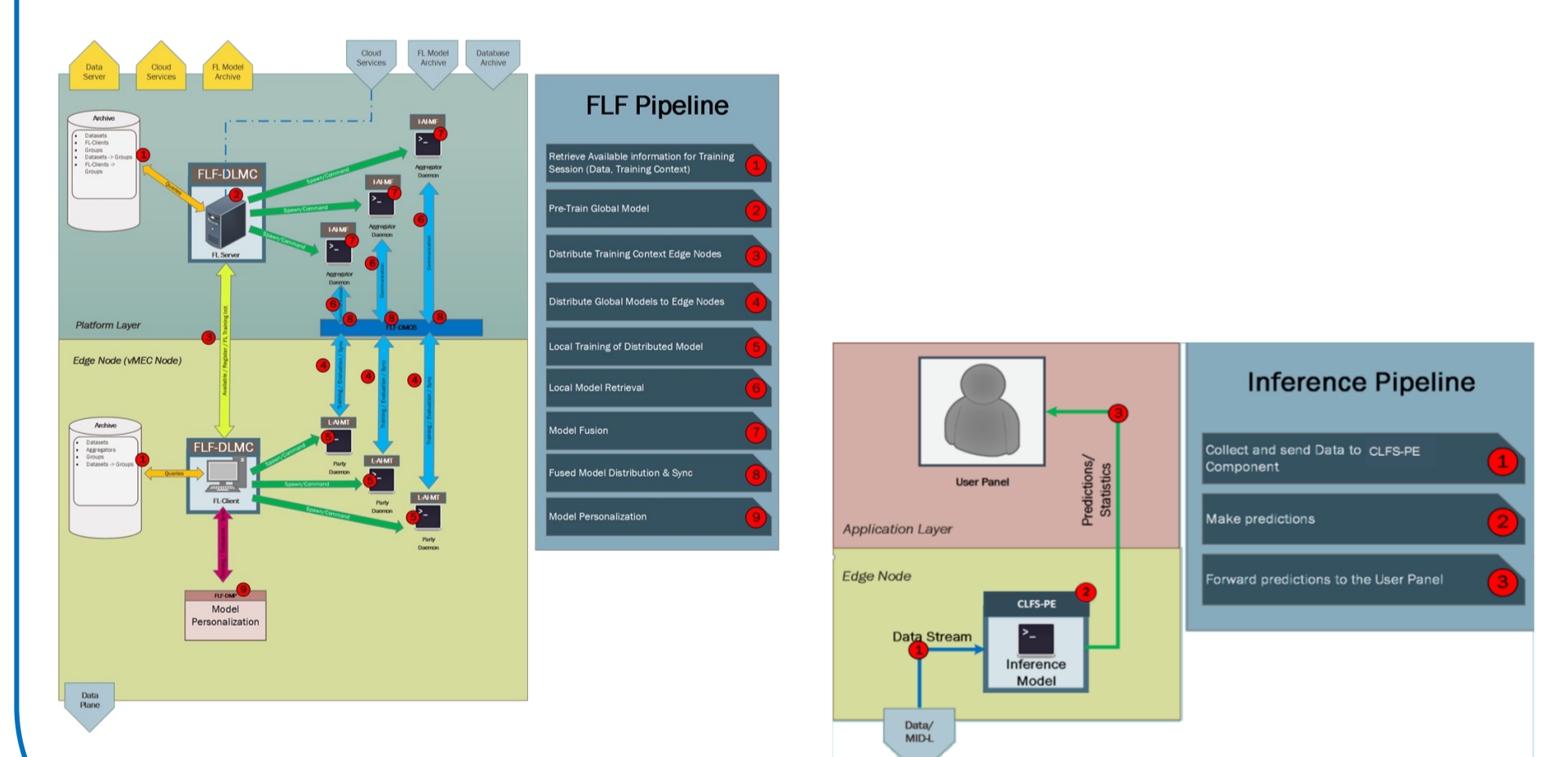
NextGenPLEDGE utilizes raw data such as pulse waveforms, temperature data and electrocardiography (ECG) waveforms captured by the wearable sensors in order to build a personalized AI-model through on-device learning and convert them into measurements of actual precise health data such as, Respiratory Rate, Blood Oxygen Saturation, Body Temperature, Heart Rate and Heart Rate Variability, while taking personal physiological and behavioural user characteristics into account. NxtGenPLEDGE became a part of the Federated learning paradigm of TERMINET as a realistic and effective synergy of IoT and AI in the high challenging and critical domain of health. Our unique proposition increases the relevance to the specific challenges of TERMINET and its innovation capacity, as well as the impact and importance of the use cases that this call is targeting (Figure 1).

Next-Gen-PLEDGE created an advanced remote monitoring systems, improving the capabilities of early detection of disease symptoms or pathology and respond to them in a timely manner. It is aligned with TERMINET's framework, for testing, validating, and demonstrating federated models and machine learning algorithms in a personalized healthcare scenario. Our concept features a personalized system—a patch and wrist wearables, coupled with a mobile device—leveraging Next Generation IoT through federated learning, bringing decisions closer to the end user.



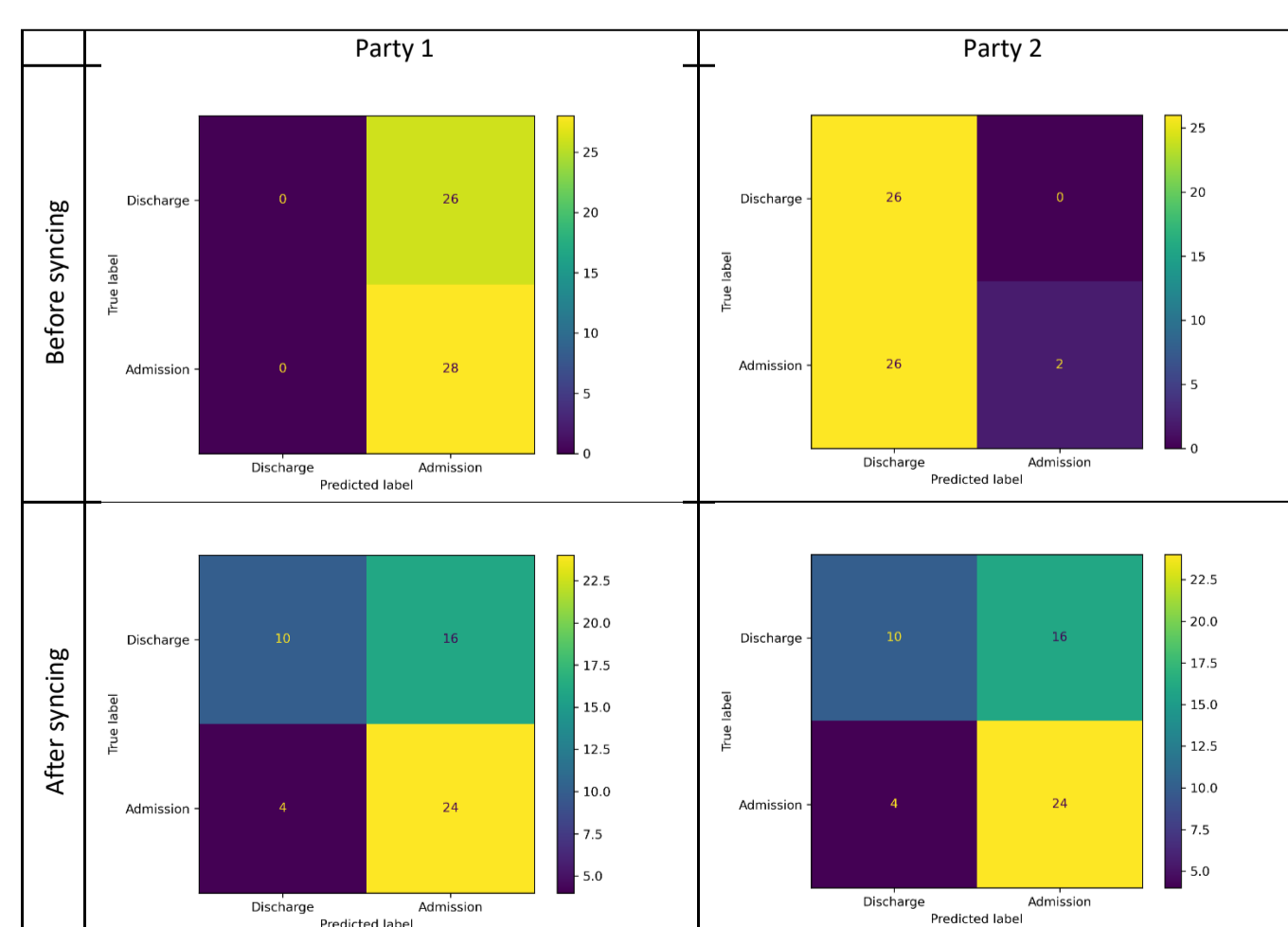
**INTEGRATION WITH TERMINET**

Next Gen PLEDGE leverages TERMINET's architecture in a scenario incorporating SOTA AI methods and algorithms for a real-life application. Our goal was to design and create a system able to provide AI-EDGE services for healthcare professionals improving procedures both in clinical and management level through TERMINET platform and to support the creation of new solutions by providing AI component through wearable technologies. Finally, we focus on overcoming the barrier of secure sharing of medical data on cloud infrastructures to re-train models at the edge to create both technical and business advantage. That is the reason that we interact with the already defined and implemented Centralized Federated Learning System developed for the TERMINET project consisting of two separate phases, the a) Federated Training and the b) Inference. These phases are described below and are provided as input to our project through the TERMINET consortium. The Federated Training procedure within TERMINET is an offline process. The process follows the described FL training pipeline as described in Section Centralized Federated Learning. Below the TERMINET FL Architecture is depicted for training (left) and inference (right)

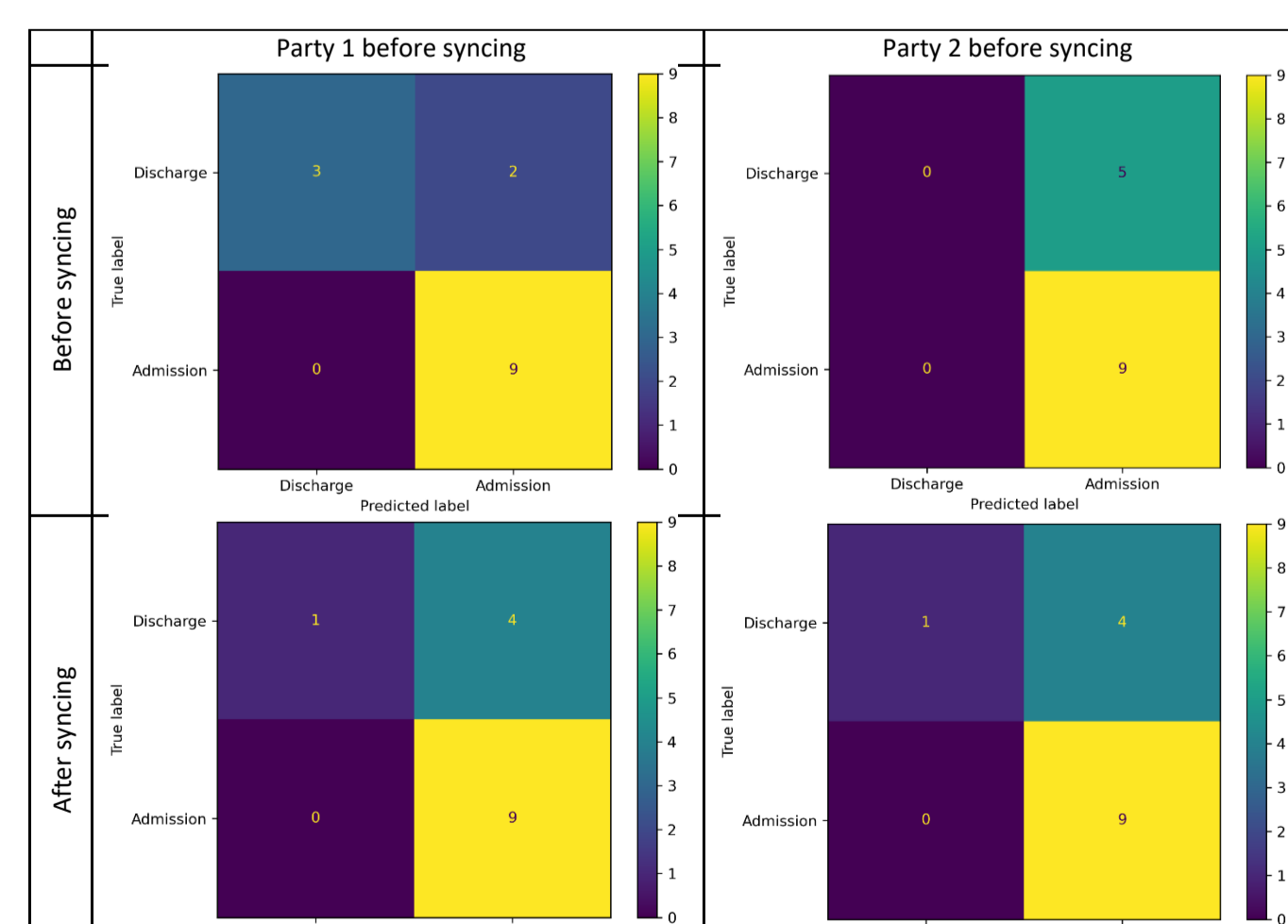


**RESULTS**

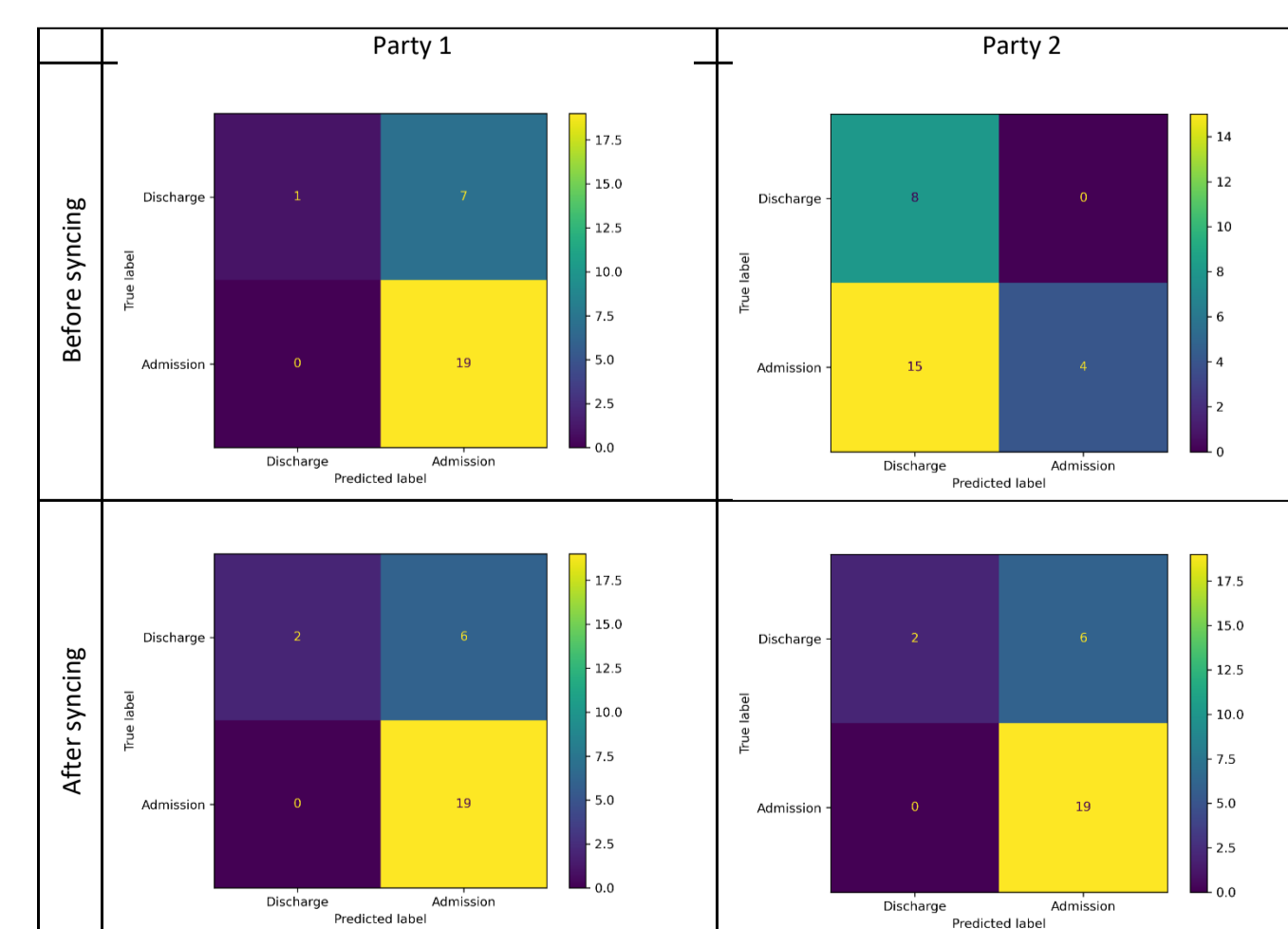
Evaluation results on a balanced split without using vital signs



Evaluation results on a balanced split, including vital signs



Evaluation results on an uneven split, without vital signs



Evaluation results on an uneven split, including vital signs

